Resource Action: EWG - 75 **Task Force Recommendation Category: 1**

Control Aquatic Weeds to Enhance Fish Habitat in the Oroville Wildlife Area

Date of Field Evaluation: N/A

Evaluation Team: Eric See and Troy Baker with input from Gail Kuestner

Description of Potential Resource Action:
This Resource Action would be designed to reduce or eliminate water primrose (*Ludwigia peploides peploides*) in selected Oroville Wildlife Area ponds. Control of this native plant would be accomplished with physical or chemical methods, or through management of water level fluctuations in affected ponds. Water primrose has been increasing in abundance since at least the mid-1990s and has caused significant, adverse ecological impacts in the Oroville Wildlife Area (OWA). This project likely would be implemented on an annual basis in the OWA unless this plant could be eradicated from selected OWA ponds.

The following resource actions are either similar to or directly related to the proposed measure:

- EWG-30, a Resource Action that is aimed at controlling invasive plants that could affect fish in the Oroville Wildlife Area.
- EWG-49, which details trout stocking programs in OWA ponds.
- EWG-50, which describes stocking warmwater species in the OWA for trophy angling areas.
- EWG-64, a Resource Action that describes the management of the OWA hydraulic regime for the benefit of targeted fish and wildlife species.
- EWG-100, a Resource Action that would be designed to increase habitat for waterfowl and wildlife in the OWA.

Nexus to Project:
- Failure of the levee on the east side of the Feather River during the 1997 flood and subsequent beaver dam activity in the OWA caused the proliferation of native water primrose in the Oroville Wildlife Area, which has resulted in a habitat decline for several important fish and wildlife species.

Potential Environmental Benefits:
- The primary intended benefit is to increase fish survival, angler access, and angler effectiveness in OWA ponds. Reducing water primrose abundance likely would result in higher foraging success and a more favorable size composition for important gamefish such as largemouth bass, in addition to providing recreational benefits. Increased levels of fish productivity in OWA ponds could enhance warm water game fish communities in the OWA.
- Waterfowl would derive benefits from decreased abundance of water primrose in OWA ponds because more habitat would be available for resting and foraging.

Potential Constraints:
Potential constraints associated with this Resource Action could include:

- Extent and duration of water level fluctuations in OWA ponds that could affect existing aquatic resources.
- Special permitting required for aerial application of herbicide under existing regulations.

- Complete map beaver dams and mechanisms for their removal not established at this stage.

Existing Conditions in the Proposed Resource Action Implementation Area:
The most significant issue affecting the OWA fisheries in the last decade has been the invasion of water primrose in the OWA on the east side of the Feather River. Water primrose is a native aquatic plant that is currently found along the margins and backwaters of the Feather River both upstream and downstream of the OWA, and has been increasing in abundance since at least the mid-1990s. During the 1997 floods, the OWA levee on the east side of the river failed near the Pacific Heights Road entrance. Following repair of this levee, a small flow of water has been passing through an unobstructed culvert at the base of the levee, and beavers have created a series of dams on this flow, which has spread the water across hundreds of acres of land that used to only flood on a seasonal basis. Now this shallow water is standing year-round, providing ideal conditions for the growth of water primrose and its abundance has increased dramatically since this time. The excessive amount of primrose in these former seasonally flooded areas has spread across the deeper, perennial, fish bearing ponds to a point where the entire surface of the pond is covered with water primrose, sometimes to a height of over 1 m above the surface of the pond (Figure 1). High abundance of aquatic plants can have negative impacts in recreational fisheries through reduced angler access and effectiveness, as well as declines in largemouth bass foraging success and population skewing toward smaller fish (Dibble et al. 1996; Killgore et al. 1989; Wrenn et al. 1996). Approximately 80% of the fish bearing ponds in this area have been covered with water primrose, and this condition is increasing annually. Vegetation mapping of the OWA as part of SP-T4 indicated that water primrose occupies approximately 400 acres in Section D of the OWA, 20 acres in the one-mile buffer zone of the Project area, and approximately 69 acres in the Feather River floodplain.

In addition to fishery impacts, hunters have noticed a dramatic decline in the waterfowl abundance in this area and this is believed related to the lack of open water. As previously stated, the water primrose will often grow in very thick mats that often extend 1 m above the surface of the water, limiting aerial access to the water as well as eliminating open areas for loafing or feeding.

In addition to the water primrose problem, the current year-round flooding has also killed several thousand Fremont cottonwood trees (*Populus fremontii*) in the OWA (Figure 2).

This condition continues to increase as the beaver activity inundates additional areas of the OWA.

General Life History of *Ludwigia peploides peploides*

Water primrose is a perennial herb that can be found creeping along the shoreline, floating on the water surface, or growing upright. It is native to California, South America and the southeastern United States, and is also found in Eurasia and Australia. The plant grows in dense mats and favors the margins of lakes, ponds, ditches, and streams. It blooms throughout the summer with bright yellow flowers (5 petals) and slightly hairy, alternate willow-like leaves. Flowering stems can rise up to three feet above the water surface. The plant reproduces by seeds and by plant fragments. The plant can be spread by water, waterfowl, and human activity (such as shipping and recreational boating). It blooms throughout the summer.

Design Considerations and Evaluation:

This Resource Action involves three different types of weed control in the OWA, mechanical, chemical, and management of water levels.

Mechanical Control

Mechanical control has been effective in removing water primrose in certain areas. Weeding or pulling water primrose by hand has been shown to eliminate small infestations, but constant upkeep is necessary if seeds have been established. Care must be taken to prevent plant fragments from escaping and further spreading the species. Ground covering with an opaque material also can be used to control water primrose. Black mylar (8 mm thickness) plastic stretched over patches of growth and fastened in place with weights will virtually destroy existing growth. Plants will return with seeds, however, so this method of control is limiting for long-term control.

In the Mendota Wildlife Area in Fresno County, California, mechanical control has been used effectively to control water primrose around irrigation control structures (R. Muddleston, personal communication, December 1, 2003). Irrigation channels were drawn down during the hottest part of summer to leave primrose plants dry for at least a week. Plants died due to lack of water and heat and were able to be raked up or removed with a small backhoe. Experimental use of the herbicides Rodeo and Garlon also have been used to control this species in the Mendota Wildlife Area (see details below under heading "Chemical Control"). It may be possible to use mechanical removal methods (e.g. backhoe, bulldozer) if flooded areas can be dewatered.

Chemical Control

A preliminary search of the literature was conducted and multiple state-level agricultural extension resources were consulted through the Internet to obtain details on water primrose control.

The active ingredients in chemicals that have been successful in treating water primrose include 2,4-D, diquat, triclopyr, and glyphosate (MDC 1999). Rodeo® was the most widely used method to control water primrose in California and in the southeastern United States, although a wide range of chemical options are available. Rodeo is a liquid glyphosate formulation that is classified as a systemic herbicide. Systemic herbicides are absorbed and move within the plant to the site of action. Application of herbicides usually requires a registered surfactant that is added to the glyphosate solution for optimal results. Rodeo can be obtained for about $50 per gallon. A surficant such as R-11® was $21 per gallon. Cost per acre for Rodeo treatment would be approximately $5-$25, depending on the desired concentration of the chemical.

A suite of other chemicals have been used across the United States for controlling water primrose. A summary of these chemicals and their active ingredients is provided in Table 1.

Table 1. Herbicide Price List for Common Chemicals to Control Water Primrose

Product/Manufacturer	Active Ingredient	Application Method	Cost/Unit[a]	Approximate Cost/Acre	CA Approved[c]
Rodeo (Monsanto)	glyphosate-ipa salt	aerial, direct	$50	$5-$25	YES
Aquamaster (Monsanto)	glyphosate-ipa salt	aerial, direct	$78	$240	YES
Aquaneat (Cerexagri)	glyphosate-ipa salt	aerial, direct	$59	$360-$900	YES
2,4-D Products (various)	2,4-D	direct	$12-$18	$1-$6	N/A
Renovate/Garlon (Dow)	triclopyr	direct	$75-100	$24-$185	NO
Navigate (Aventis)	2,4-D	granular	$2	$200-$400	NO
Reward[b] (Syngenta)	diquat	direct	$113	$50-$75	YES

[a] Prices from 2003 North Dakota Weed Control Guide, Ducar and MacDonald 2003, Vandiver and Ducar 2002

[b] Reward™ was not recommended for treatment of water primrose by the Missouri Department of Conservation compared to other chemicals (MDC 1999).

[c] Approved chemical by California Department of Pesticide Regulation (12/02/03)

In the Mendota Wildlife Area, California, Rodeo and Garlon® have been used to control water primrose (R. Muddleston, personal communication, December 1, 2003). The application of the herbicides usually occurred during fall (Sep-Nov) before the fall flood-up period. Irrigation canals in the Mendota Wildlife Area were drawn down to strand

water primrose. Herbicides were added to the plant and the canals were flooded after about a week. With a week of draw down, this method was about 80 percent effective at reducing water primrose in the immediate vicinity of irrigation diversions. This method must be repeated each year and has varied in effectiveness, depending on weather conditions and the amount of primrose present. The Mendota Wildlife Area obtained approval for chemical application of these chemicals through the pest control advisor for California Department of Fish and Game. No adverse biological interactions were observed with application of these chemicals (R. Muddleston, personal communication, December 1, 2003). This is supported by numerous studies that indicate proper application of herbicides do not adversely affect fish (Applied Mammal Research Institute 2003), lizards and snakes (Campbell and Campbell 2002), and other non-target species such as birds.

Biological Interactions of Chemical Agents

DFG has addressed the toxicological impacts of Rodeo on larval fathead minnows (*Pimephales promelas*) and larval southern leopard frogs (*Rana pipiens*) during control of giant cane (Team Arundo Del Norte 2003; http://www.teamarundo.org). The demonstration project was located at Gray Lodge Wildlife Area in Butte County, California. The 96-hour LC50 values for glyphosate for larval frogs and fathead minnows were found to be greater than 1,211 mg/L and 1,240 mg/L, respectively. Water samples collected from adjacent waterways one hour after aerial herbicide applications contained concentrations ranging from 0.057 to 0.155 mg/L. These experimental values indicated a 10,000-fold margin of safety for larval fathead minnow and southern leopard frogs when glyphosate is applied by air.

The 96-hour LC50 for the surfacant R-11 for bluegill sunfish (*Lepomis macrochirus*) and rainbow trout (*Oncorynchus mykiss*) is approximately 4.0 mg/L (Team Arundo Del Norte 2003; http://www.teamarundo.org). Water samples collected one hour after the herbicide/surfactant application contained a maximum surfactant concentration of 0.013 mg/L. These concentrations indicate a minimum 100-fold margin of safety for fish when the surfactant is applied directly to water.

Regulatory Requirements for Pesticide Use in California

The Department of Pesticide Regulation provides control over pesticide use in California. Only products registered in California may be used legally to control undesired plants. At least four chemicals that have been used successfully in other areas to control water primrose are registered in California (Table 1). Numerous chemicals with the active ingredient 2,4-D have been used for primrose control, but specific chemicals were not queried with the State at this time.

Management of Water Levels

Water level management is an important component in controlling water primrose, as well as reducing the destruction of Fremont cottonwood trees (Populus fremontii). This would be accomplished in two ways, plugging the culvert at the base of the levee where the water enters the OWA, and removing beaver dams.

The water enters the OWA through a culvert at the base of the levee near the Pacific Heights Road entrance. Plugging the culvert would need to be assessed on-site with DWR Oroville Field Division staff, but would probably entail covering the openings with metal doors, placing fill material above and/or below the culvert, or some combination of the two.

Beaver Dam removal would also require on-site assessments by DWR Oroville Field Division staff, to map the existing dam network, and develop the specific activities for each dam removal. This would involve the use of heavy equipment, as well as hand crews to remove the dams. This activity could be combined with other activities such as chemical treatments.

Synergism and Conflicts:

Synergisms could be created if this measure is planned in conjunction with other Resource Actions designed to enhance aquatic, terrestrial, and waterfowl communities in the OWA. This could include EWG-30, which also is aimed at controlling aquatic weeds for the benefit of fish habitat. This could also include EWG-49 and EWG-50, which detail potential stocking programs in OWA ponds. This Resource Action would be compatible with EWG-64 that describes the management of the OWA hydraulic regime for the benefit of targeted natural species. This Resource Action also would create a synergism with the action designed to increase habitat for waterfowl and wildlife in the OWA (EWG-100). Finally, the Resource Action to eliminate noxious plants in the OWA (EWG-76) would be similar to this Resource Action.

A potential conflict could be created with EWG-97, which would seek to increase floodplain connectivity between the Feather River and selected OWA ponds during high flows. Another conflict may occur with the Federal Endangered Species Act since red-legged frogs (*Rana aurora*) and giant garter snakes (*Thamnophis gigas*), both threatened species, may occur in the area.

Uncertainties:

The main uncertainty associated with this Resource Action would be predicting the level of success with these actions. Aquatic plant management is often a difficult task, particularly in remote locations with limited access, such as in the OWA. An additional uncertainty would be related to permitting requirements for aerial application of herbicide and potential impacts to non-target species in the OWA.

Cost Estimate (Annual):

Periodic removal of beaver dams in the OWA would result in relatively small, but ongoing expenditures in future years. Removal of less than 10 beaver dams annually could cost between $1,000 to $10,000, depending on their size, accessibility, and

construction. It is anticipated that costs would go down after the initial removal effort, which will cost about $20,000.

Mechanical control would be limited to accessible areas, and this would depend upon the success in dewatering the current primrose areas. It is anticipated that costs would go down after the initial removal effort, which is estimated at $15,000.

The estimated range of costs for chemical control would be $100 to $ 150 per acre, and about 150 acres would need to be treated. This acreage is an estimate, and assumes that water control measures would also take place, which would reduce the overall primrose area that would need to be treated. It is anticipated that costs would go down after the initial treatment, which will cost about $20,000.

Plugging the culvert at the base of the levee would be a relatively simple operation and would cost from $1500 to $3000 to complete.

Total: Approximately $70,000 (including permitting) for the first year effort, and 15,000/year thereafter for the next 4 years. The efforts will be reassessed after 5 years to determine the effectiveness of the project, and whether the ongoing maintenance should be continued.

Recommendations:

This Resource Action should be considered as an alternative for mitigating the potential negative effects of project operations on warm water game fish in the Oroville Wildlife Area. This project is designed to strengthen warm water game fish communities in selected OWA ponds for increased angler success and satisfaction. In addition to fisheries benefits, reducing the abundance of water primrose in the OWA is thought to provide a habitat benefit for waterfowl, thereby increasing hunter satisfaction. Reducing the amount of perennial flooded areas will allow for re-establishment of cottonwood trees in the OWA, and will halt the destruction of additional existing cottonwoods.

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Figure 1. OWA pond with water primrose – upper photo:10/17/00 lower: 9/08/03

Figure 2. Cottonwood trees killed by beaver dam impounded water